GOALS ADAPTED FROM THE NATIONAL MARINE SANCTUARIES ACT (16 U.S.C. 1431)

After reaching a consensus on a draft action plan, the Marine Protected Areas (MPA) working group has begun work on the first step, focused on gathering background information and adding details to goal statements. The purpose of this step in part is to complete strategy 2.1 of the plan, building on the existing general goal statement of the working group, and to further articulate the plan's conservation, research, educational, and social goals.

The National Marine Sanctuaries Act (NMSA) was used as the foundation for establishing these conservation goals. ***The text in bold*** *is taken from the findings, purposes and policies section of the NMSA. The NMSA language serves as general headings under which the group identified specific goals for the MPA plan.*

I. General Goals and Objectives

The MPA working group focused on the following three policies from the NMSA:

(1) **to maintain the natural[1] biological communities in the national marine sanctuaries, and to protect, and, where appropriate, restore and enhance natural habitats, populations, and ecological processes;**

(2) **to enhance public awareness, understanding, appreciation, and wise and sustainable use of the marine environment, and the natural, historical, cultural, and archeological resources of the National Marine Sanctuary System;**

(3) **to support, promote, and coordinate scientific research on, and long-term monitoring of, the resources of these marine areas; and**

(4) **to facilitate to the extent compatible with the primary objective of resource protection, all public and private uses of the resources of these marine areas not prohibited pursuant to other authorities.**

II. Specific Objectives

This section presents a brief list of the conservation goals discussed and selected by the working group. For more detail and examples, refer to the Appendix.

[1] The working group recognizes that the words "natural" is sometimes difficult to define for a number of reasons, including ecosystem variations, lack of historic information and definition of a baseline, and spatial and temporal variations.

Conservation

(1) to maintain the natural biological communities in the national marine sanctuaries, and to protect, and, where appropriate, restore and enhance natural habitats, populations, and ecological processes;

Targets for conservation include aspects of each level of biological organization. *Individual organism*-level targets include traits of individuals, such as condition, age, size, and reproductive capacity as well as each individual's contribution to genetic diversity. *Population*-level targets include such attributes as the density (number of individuals per unit area) and abundance necessary for a species to maintain an ecological role in a local community, as well as the size and age structure of a population. *Species*-level targets include such characteristics as rare, endangered or endemic species, those with particularly important ecological roles/niches and those of economic importance. *Community*-level targets include the composition and diversity of species, among other elements. *Ecosystem*-level targets include ecosystem structure (biological and physical), including the natural composition, diversity, and habitat types; ecosystem processes (i.e., structure and function), including productivity, species interactions, and trophic interactions; and variability. In addition, *habitat* targets include habitat representation at all spatial scales (within and among bioregions) to encompass their range of biodiversity and habitat functions as well as key (i.e. particularly important) functional habitats.

Educational and Social

(2) **to enhance public awareness, understanding, appreciation, and wise and sustainable use of the marine environment, and the natural, historical, cultural and archaeological resources of the National Marine Sanctuary System;**

Under this objective, the MPA working group has four goals, (1) promoting understanding and stewardship of healthy marine ecosystems, (2) enhancing understanding of natural and human impacts and their implications for resource management and economics, (3) enhancing public understanding of what role MPAs may play (or are playing) in managing the Sanctuary's resources, and (4) ensuring that these resources are used in such a way as to protect their long-term health and integrity.

Research

(3) **to support, promote, and coordinate scientific research on, and long-term monitoring of, the resources of these marine areas;**

The MPA working group has two primary research goals associated with MPAs; (1) to use them as a tool to identify and distinguish natural from human induced change and, (2) to guide conservation and management by monitoring the effectiveness of any marine protected areas within the MBNMS. Both of these goals seek to improve understanding of the natural processes in the Sanctuary by monitoring long-term changes in communities and the physical characteristics of the environment. In achieving these goals it is the objective of the MPA working group to contribute to the evolving science

of marine protected areas.

Compatible Use

(4) **to facilitate to the extent compatible with the primary objective of resource protection, all public and private uses of the resources of these marine areas not prohibited pursuant to other authorities.**

Consider the kinds and levels of public and private use of and impacts to resources that are compatible with resource protection. Considering the resources, their use, and the associated impacts will play a key role in determining what types and level of uses are compatible.

Consider the historical, cultural, and economic role of compatible consumptive and non-consumptive uses (such as recreational and commercial fishing, diving, tourism, research, wildlife viewing etc.)

These uses are dependent on a healthy marine ecosystem.

Appendix

Conservation

(1) to maintain the natural biological communities in the national marine sanctuaries, and to protect, and, where appropriate, restore and enhance natural habitats, populations, and ecological processes;

Specific Conservation Goals

Individual organism level objectives

- unique individual contribution to genetic diversity (e.g, disease resistance, capacity to adapt to environmental change)
- heterozygosity (avoids inbreeding depression)
- genetic diversity
- lifespan ("storage effect": adults "store" reproductive capacity for favorable recruitment conditions; also parental care role)
- individual condition, size, age and reproductive capacity size: size-relate offspring production
- individual – habitat size requirements (i.e. home range, migration)
- individual larval condition, including viability, etc.

Population level objectives[2]

- abundance- avoid extinctions induced by human activities (e.g. extraction, habitat modification/destruction)
- species' ecological role in local community/ecosystem (= "ecological extinction")
- buffer vulnerability to natural perturbations that make populations both more susceptible to environmental perturbations and slower to recover
- density: buffer to Allee effects, genetic drift, inbreeding depression (problems associated with small populations)
- interactions between density, social structure, reproduction
- species range and metapopulation integrity and stepping-stone role in connectivity
- population structure: size, age, sex ratios
- genetic diversity
- spatial genetic structure (spatial patterns of genetic diversity)
- resource requirements (habitat quantity and quality, food)

Species level objectives

- rare, endangered, endemic species
- species resources (food, nursery, spawning)
- ecologically important roles/niches

[2] Which species to be considered is to be decided

- productivity (kelp)
- habitat engineer (kelp)
- nursery habitat for other species
- source of refuge from causes of mortality (environmental, competition, predation)
- modification of physical/chemical environment (e.g. kelp currents)
- mutualisms, facilitation (positive species interactions)
- trophic role (amphipods, fishes)
- biodiversity (e.g. keystone predator)
- redundancy-community/ecosystem stability
- regulate prey - community stability
- umbrella species - proxies of community & ecosystem state
- economically important species

Biological community level objectives[3]

- species composition and diversity: abundance, biomass, trophic and functional levels (co-evolved assemblages of native species)
  - alpha diversity (within-habitats)
  - beta diversity (between habitats)

  example: "not all kelp beds are alike" – representation
- species composition: determines species interactions and strength
- types of natural selection
- species interactions (e.g., predator/prey, competition, keystone species)
- sources of disturbance / heterogeneity = diversity
- diversity-stability of populations and communities (e.g. population regulation, functional redundancy)
- productivity
- bottom line: species interactions = community stability

Ecosystem level objectives

- ecosystem structure (biological and physical), including the natural composition, diversity, and habitat types
  - species composition (identity of particular species)
  - species diversity (richness and relative abundance)
  - geologic/oceanographic habitat types and their diversity
  - habitat representation (reefs, soft bottom, estuarine)
- ecosystem processes (i.e., structure and function), including productivity, species interactions, and trophic interactions
  - productivity (biomass production: kelp forest vs. sandy bottom)
  - nutrient production, levels, cycling (photosynthesis, nitrogen fixation – bacteria)

[3] NMSA reads "…of the natural assemblage of living resources that inhabit these areas." The group provided this clarification between the legislative and current scientific language.

- benthic/pelagic coupling (e.g., planktivores and zooplankton)
- species and trophic interactions (food webs)
- biological habitats and their diversity (kelp, sea grasses, mussel beds)
- species-environment interactions (kelp beds reduce coastal erosion)
- variability -- contributes to species diversity
- gradual change (seasonal, annual) allows for species coexistence
- disturbance produces habitat diversity – e.g., boulders "patch dynamics" protect both biotic and abiotic sources of disturbance (bat rays, whales)

- mechanisms of regulation (feedback) – contributes to stability/persistence
  - climate (micro to regional) regulation
  - trophic loops – predators (kelp rockfish) eat grazers (crustaceans) which eat algae (giant kelp) which provides habitat/shelter for rockfish recruits

Habitat level objectives

- Habitat representation at all spatial scales to encompass the range of biodiversity and habitat functions (within and among bioregions) including:
  - wetlands, estuaries and adjacent critical areas
  - sandy/muddy intertidal
  - submarine canyons
  - rocky intertidal
  - sea grass beds
  - nearshore rocky reef and kelp
  - nearshore soft bottom
  - rocky deep shelf and slope
  - soft bottom deep shelf and slope
  - open water
- Key functional habitats including:
  - nurseries
  - feeding grounds
  - juvenile settlement habitat
  - spawning habitat
  - migratory corridors

<u>Educational and Social</u>

(2) **to enhance public awareness, understanding, appreciation, and wise and sustainable use of the marine environment, and the natural, historical, cultural, and archeological resources of the National Marine Sanctuary System;**

- public awareness
- understanding
- appreciation
- management
- wise and sustainable use of the marine environment
- natural resources

- historical resources
- archaeological resources
- cultural resources

Research

(3) **to support, promote, and coordinate scientific research on, and long-term monitoring of, the resources of these marine areas;**

- conduct research on natural processes
- monitor long-term changes in communities and physical characteristics
- distinguish natural from human induced change
- evaluate performance of management
- use research to guide conservation and management, including adaptive management
- contribute to the evolving science of marine protected areas

Compatible Use

(4) **to facilitate to the extent compatible with the primary objective of resource protection, all public and private uses of the resources of these marine areas not prohibited pursuant to other authorities**

Consider the kinds and levels of public and private use of and impacts to resources that are compatible with resource protection. Considering the resources, their use, and the associated impacts will play a key role in determining what types and level of uses are compatible.

Consider the historical, cultural, and economic role of compatible consumptive and non-consumptive uses (such as recreational and commercial fishing, diving, tourism, research, wildlife viewing etc.)

These uses are dependent on a healthy marine ecosystem.

The conservation goals emphasize the importance of biodiversity. What follows is intended to explain the meaning and importance of biodiversity

What is biodiversity?

> ***Conservation:***
> *The act or process of conserving. The controlled use and systematic protection of natural resources.*
>
> *(From Webster's Dictionary)*

Three definitions:

"The collection of genomes, species, and ecosystems occurring in a geographically defined region."

"Biological diversity encompasses all species of plants, animals, and microorganisms and the ecosystems and ecological processes of which they are parts. It is an umbrella term for the degree of nature's variety, including both the number and frequency of ecosystems, species, or genes in a given assemblage. It is usually considered at three different levels: genetic diversity, species diversity, and ecosystem diversity…Ecosystem diversity relates to the variety of habitats, biotic communities, and ecological processes in the biosphere, as well as the tremendous diversity within ecosystems in terms of habitat differences and the variety of ecological processes. Ecosystems cycle nutrients (from production to consumption to decomposition), water, oxygen, methane, and carbon dioxide (thereby affecting the climate), and other chemicals such as sulphur, nitrogen, and carbon."[4]

"Diversity in genes, species, and ecosystems provides the raw materials with which different human communities will adapt to change, and the loss of each additional species reduces the options for nature—and people—to respond to changing conditions."[5]

Biological diversity is a catch-all term for (1) the diversity of all categories of biological organization [i.e., genes, individuals, populations, taxa (such as species), communities, ecosystems]; (2) those processes that contribute to the creation and maintenance of diversity, such as species interactions, ecosystem structure and functions; and (3) habitats, including the geological, hydrological, oceanographic components that support and create diversity."[6]

Reasons for Conserving Biodiversity

The biodiversity of a region contributes **values** to human populations. Such values are mostly service-oriented and common to all levels of biodiversity. Biodiversity values recognized by the SMPA working group include:

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[4] National Research Council. 1995. Understanding Marine Biodiversity. National Academy Press, Washington, D.C. 114pp.

[5] McNeely, J.A., K.R. Miller, W.V. Reid, R.A. Mittermeier, and T.B. Werner. 1990. *Conserving the World's Biological Diversity*. IUCN, Gland, Switzerland; WRI, CI, WWF-US, and the World Bank, Washington, D.C. 193pp.

[6] Groves, C.R. 2003. *Drafting a Conservation Blueprint: a practitioner's guide to planning for biodiversity.* Island Press, Washington, D.C. 457pp.

- Ecological (diversity-stability and diversity-productivity relationships)
- Ethical (stewardship of natural world and for future generations)
- Aesthetic (human appreciation for natural diversity)
- Cultural (e.g., recreational, religious)
- Economic (e.g., tourism, recreation, fisheries, genetic resources, medicine, technological innovation—biomechanics)
- Educational (e.g., study of nature)
- Scientific (to study and understand intact ecosystems)
- Management (baseline for identifying the types and magnitude of human impacts)

Biological resource values fall into two categories: **consumptive values**, which include marketed (commercial) and non-marketed (recreational) values, and **non-consumptive values**, which include education, science, recreation, option value (i.e. value of having future options), and existence value (ethical feelings for existence of wildlife). [In both cases—consumptive and non-consumptive—biodiversity enhances the stability and sustainability of goods and services provided to humans.]

These values reflect **services** and **resources** provided to humans by marine species and ecosystems. Examples include:

- food (fisheries, aquaculture)
- DNA (for medical research and medicines)
- species interactions (e.g., biological control of undesired species and pathogens)
- products (e.g., chemicals, materials [e.g., algin from kelp, jade], medicines)
- nutrient generation/cycling/retention (oxygen, carbon, other elements)
- productivity (fish production, kelp production)
- absorption and breakdown of pollutants/toxicants (water purification)
- water quality/purification (e.g., filter feeders- turbidity, bioremediation)
- amelioration of physical disturbance (e.g., kelp-coastal erosion)
- economic values (e.g., recreation, tourism, aquaria, transportation
- geologic resources (e.g., sand, jade)
- aesthetic valuation (e.g., viewsheds, real estate)
- attributes of water (e.g., drinking water – desalination, dilution - waste disposal, cooling - power plants)

Biodiversity contributes to **ecosystem functions** that influence the stability and persistence of an ecosystem:

- nutrient cycling/retention (nitrogen, carbon, elements)
- energy cycling
- oxygen production
- buffer to natural fluctuations (e.g., climatic variation) in food supply, nutrient flux, etc. (e.g., population buffers)
- dampens (i.e. regulates) ecosystem variability (e.g., species complimentarity)
- ecological roles (e.g., food chain components)
- habitat structure (e.g., kelp, sea grass, mussel beds and other engineers)

- habitat stabilization (erosion prevention)
- genetic diversity

Consequences of not conserving biodiversity:

- Loss of diversity: monocultures = monotony
- Loss of cultural values - aesthetics, history, spirituality
- Loss of economic value - tourism, recreation, fisheries, genetic resources, medicine
- Loss of future potential - products, medicine, technological innovations, etc.
- Loss of species and ecosystem services (both natural and economic)
- Loss of education opportunities
- Loss of scientific knowledge